

I Claim:

1. A method for assessing the physiological condition of a biological material, comprising:

maintaining at least one sample population of the biological material in one of the following systems: a cell culture system; a tissue culture system; an organ culture system; and an intact organism;

acquiring test data relating to one or more geometrical or optical properties of the sample population; and

comparing the test data acquired to comparison data relating to one or more geometrical or optical properties of a comparison cell population, the comparison data representing one or more geometrical or optical properties of the comparison cell population in a predetermined physiological state, whereby changes in the one or more geometrical or optical properties reflected in the test data compared to the comparison data represent changes in the physiological state of the sample population.

2. A method of claim 1, additionally comprising acquiring multiple test data sets relating to one or more geometrical or optical properties at multiple, predetermined spatial locations in the sample population.

3. A method of claim 1, additionally comprising exposing the sample population to a physiological challenge prior to acquiring the test data.

4. A method of claim 3, additionally comprising acquiring control data relating to the one or more geometrical properties of the sample population prior to exposing the sample population to a physiological challenge.

5. A method of claim 4, additionally comprising comparing the test data to the control data to assess changes in the one or more geometrical or optical properties of the sample population representing changes in the physiological state of the sample population.

6. A method of claim 1, wherein the comparison data is derived from empirically determined controls.

7. A method of claim 3, wherein the physiological challenge is selected from the group consisting of: exposure to a test agent, a test condition, a drug, a hormone, a biological agent, a toxin, an infectious agent, radiation, chemotherapy, deprivation of a metabolite or nutrient, electrical stimulation, inflammatory agent, oncogen.

8. A method of claim 1, additionally comprising maintaining multiple sample populations in an *in vitro* culture system.

9. A method of claim 1, wherein the test data acquired relates to one or more optical properties selected from the group consisting of: reflection, refraction, diffraction, absorption, scattering, birefringence, refractive index and Kerr effect.

10. A method according to claim 1, wherein the biological material is a viable sample population maintained in a cell culture system.

11. A method according to claim 1, wherein the biological material is a viable, intact organism.

12. A system for assessing the physiological condition of a biological material, comprising:

a platform for supporting an optically transparent container of biological material;

an illumination source for illuminating the biological material;  
an optical detector for acquiring test data relating to a geometrical or optical property of the biological material; and

a data storage and analysis device for storing data relating to a geometrical or optical property of the biological material, and comparing test data with a control data profile to generate a comparison data set relating to geometrical or optical property of the biological material;

13. A system of claim 12, wherein the platform is an automated stage operated by a control device capable of locating and moving the stage to predetermined x-y coordinates.

14. A system of claim 12, additionally comprising a data output device capable of displaying the comparison data in a visual format.

15. A system of claim 14, wherein the data output device is capable of displaying comparison data in a graphical or image format.

16. A system of claim 12, wherein the optical detector is a charge coupled device (CCD).

17. A method for identifying optical contrast enhancing agents useful for enhancing the sensitivity of optical detection of a biological material comprising:

maintaining at least one sample population of the biological material in one of the following systems: a cell culture system; a tissue culture system; an organ culture system; and an intact organism;

exposing the at least one sample population to a candidate optical contrast enhancing agent;

acquiring test data relating to one or more optical properties of the sample population subsequent to exposure to the candidate optical contrast enhancing agent; and

comparing the test data acquired to comparison data relating to the one or more optical properties of the sample population.